

CLAIMS

1. An electromagnetic driving device comprising;  
a movable core,  
a stator having a housing portion for  
5 housing said movable core in such a manner as to move in  
a reciprocating fashion therein and an attracting portion  
between which and said movable core a magnetic force is  
generated for attracting said movable core to one of  
reciprocating movement directions and cooperating with  
10 said movable core to form a magnetic circuit,  
a coil for generating a magnetic force  
which attracts said movable core to said attracting  
portion side when energized, and  
a non-magnetic layer formed on at least  
15 one of sides where said housing portion and said movable  
core are situated, respectively, to diametrically face  
each other,  
and wherein  $R$  defined as  $(d_1/d_0) \times 100$  is  
set so as to satisfy  $20\% \leq R \leq 60\%$ , when a magnetic gap  
20 which is formed in a radial direction between the housing  
portion and the movable core and excludes the non-  
magnetic layers is defined as  $d_0$  and air gap which is  
formed in a radial direction between the housing portion  
and the movable core and includes the non-magnetic layers  
25 when the movable core does not deviate from, but remains  
coaxial with, the housing portion defined as  $d_1$ ,  
and wherein any of said attracting  
portion, said housing portion and said plunger portion  
becomes saturated magnetically when the value of electric  
30 current that is supplied to said coil increases to reach  
a predetermined value which falls between 40% or larger  
and 60% or smaller of a maximum value of electric current  
that is supplied to said coil.
2. An electromagnetic driving device as set forth  
35 in Claim 1, wherein a non-magnetic layer is formed on at  
least one of sides where said housing portion and said

movable core are situated, respectively, to diametrically face each other, and wherein the total thickness of said non-magnetic layer so formed falls between 40 $\mu$ m or larger and 80 $\mu$ m or smaller.

5           3.    An electromagnetic driving device as set forth in Claim 1 or 2, wherein the hardness of at least one of sliding surfaces of said housing portion and said movable core is made equal to or larger than HV200, and wherein a difference in hardness between said sliding surfaces is  
10           equal to or smaller than HV300.

          4.    An electromagnetic driving device comprising;  
                  a movable core,  
                  a stator having a housing portion for  
housing said movable core in such a manner as to move in  
15           a reciprocating fashion therein and an attracting portion between which and said movable core a magnetic force is generated for attracting said movable core to one of reciprocating movement directions and co-operating with said movable core to form a magnetic circuit, and  
20           a coil for generating a magnetic force which attracts said movable core to said attracting portion side when energized, wherein  
                  a non-magnetic layer is formed on at least one of sides where said housing portion and said movable  
25           core are situated, respectively, to diametrically face each other, and wherein the total thickness of said non-magnetic layer so formed falls between 40 $\mu$ m or larger and 80 $\mu$ m or smaller.

30           5.    An electromagnetic driving device as set forth in Claim 4, wherein the hardness of at least one of the sliding surfaces of said housing portion and said movable core is made equal to or larger than HV200, and wherein a difference in hardness between said sliding surfaces is equal to or smaller than HV300.

35           6.    An electromagnetic driving device comprising;  
                  a movable core,

a stator having a housing portion for housing said movable core in such a manner as to move in a reciprocating fashion therein and an attracting portion between which and said movable core a magnetic force is generated for attracting said movable core to one of reciprocating movement directions and co-operating with said movable core to form a magnetic circuit, and

a coil for generating a magnetic force which attracts said movable core to said attracting portion side when energized, wherein

the hardness of at least one of sliding surfaces of said housing portion and said movable core is made equal to or larger than HV200, and wherein a difference in hardness between said sliding surfaces is equal to or smaller than HV300.

7. A flow rate controlling apparatus comprising;

a housing having a plurality of fluid paths which penetrate through a cylindrical circumferential wall,

an electromagnetic driving device as set forth in any of Claims 1 to 6,

a movable member adapted to reciprocate together with said movable core to thereby control the flow rate of fluid flowing through said fluid paths, and

biasing means for biasing said movable member in a direction opposite to a direction in which said movable core is attracted by said attracting portion.